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AGRICULTURAL Research

December/1958

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Need

Agricultural research faces a challenge in the residues from insecticides, herbicides, fungicides, and other pesticides.

Industry, State, and Federal researchers have made phenomenal progress over the last 15 years in developing a wide range of pesticides—in fact, there's an effective control for every major pest. Yet, many of these chemicals can't be recommended because we don't know enough about the residues.

Take the control of insects that attack livestock. We have some new insecticides that give excellent results, but we must be careful in choosing these chemicals for specific uses because of the risk of residues appearing in the milk.

Agricultural research must develop more pest controls that protect crops and livestock without leaving illegal residues. We must also consider such matters as personal exposure to chemicals recommended for use, water pollution, and adverse effects on beneficial insects, fish, and wildlife.

Here are some jobs that need increased attention at once:

Develop other biological controls for use in certain situations that we haven't been able to handle with chemicals (there's evidence that some biological methods may even have possibilities as eradication tools). Work out more genetic and cultural controls that farmers can adopt in place of chemicals. Explore new approaches to insect control, such as the present use of atomic energy to eradicate the screwworm in the Southeast. Build the list of chemicals that will give effective control without leaving harmful residues. Devise additional attractants or lures that may be combined with chemicals to reduce the amount of toxicant needed in insecticides.

Of course, chemicals will continue to provide most of our protection against pests. You see, not a single one of our basic crops can now be grown profitably without protection from insects and diseases—and chemicals are the only dependable weapon we have against many of these enemies.

So it ought to be understood that we've got to have pesticides to keep this country going. Without them, we can't maintain our agricultural production high enough, or insure the quality of products that the public has come to expect.

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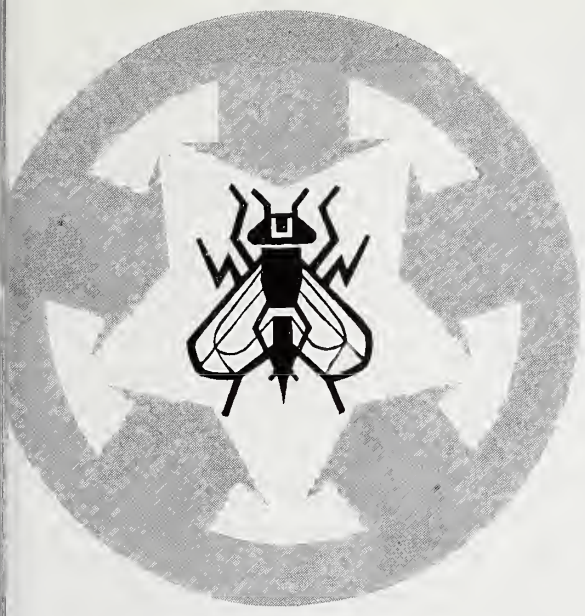
AGRICULTURAL RESEARCH SERVI
United States Department of Agriculture



To deal with insects, we need to know much more about the complex of related physical factors (climate, for example) and biological factors (such as parasites) that affect insects—factors combining to form what scientists call ecosystems. We're learning from studies of

INSECTS AND ECOSYSTEMS

■ *Entomologists are paying more and more attention to ecosystems.*

An ecosystem is made up of the physical and biological influences affecting an individual insect, the population (those of the same kind), and the community (different kinds).

Physical influences include climate and insecticides. These are known as density-independent *factors—they destroy a constant percent of insects regardless of population size.*

Biological influences include parasites, predators, competition for space and food resources. These are known as density-dependent *factors—usually, percent of insects destroyed increases as population increases (some inverse situations do occur).*

Certain climatic effects also may depend on density. That is, insects on the outside of a cluster might be affected, but not those inside.

Some people believe that the fluctuations of insect population depend on chance change of one or more environmental factors. Others say the cycles include both environmental and physiological causes, and could be calculated if mathematicians had the key. Biologists would have to provide information on the effect of factors individually and combined.

USDA entomologists are trying to learn more about the complex of related factors forming ecosystems.

1

A physical factor: CLIMATIC EFFECTS

To determine the effect of climate (a physical, or density-independent, factor) on population survivals, entomologists have tested reactions of the Mexican fruit fly in bioclimatic cabinets simulating the different temperature and humidity of various localities in the United States.

Similar walk-in cabinets were used (Agr. Res., August 1954, p. 7) to study climatic requirements of the Oriental fruit moth, Mediterranean fruit fly, and melon fly. The Mexican fruit fly was studied at Brownsville, Texas, by ARS entomologist N. E. Flitters in cooperation with P. S. Messenger, California Agricultural Experiment Station.

Researchers duplicated weather patterns of different sections of the country to learn climatic requirements of the insect. Results could influence eradication programs and be a basis for establishing trapping dates. Some States could eliminate detection systems if they knew the insect would not become established under the local climatic pattern.

Experiments indicate that a permanent population of the fruit fly could develop only in coastal areas of southern California and the Gulf of Mexico and most of Florida. Presumably,

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INSECTS AND ECOSYSTEMS

(Continued)

CABINETS enable scientists to see how insects react to weather patterns of various parts of United States. Heat, humidity, light are closely controlled in inner rooms.

MEXICAN fruit fly can stand a range of climate. Female's needlelike ovipositor can put eggs even beneath thick citrus rinds.

seasonal dispersion from these centers of permanent infestations might occur each fall and winter, but it is not anticipated that these would become permanently established.

Having completed work on fruit flies, the Brownsville laboratory has now been organized to do basic research on the effects of climate on the development, behavior, and distribution of various insects and mites.

2

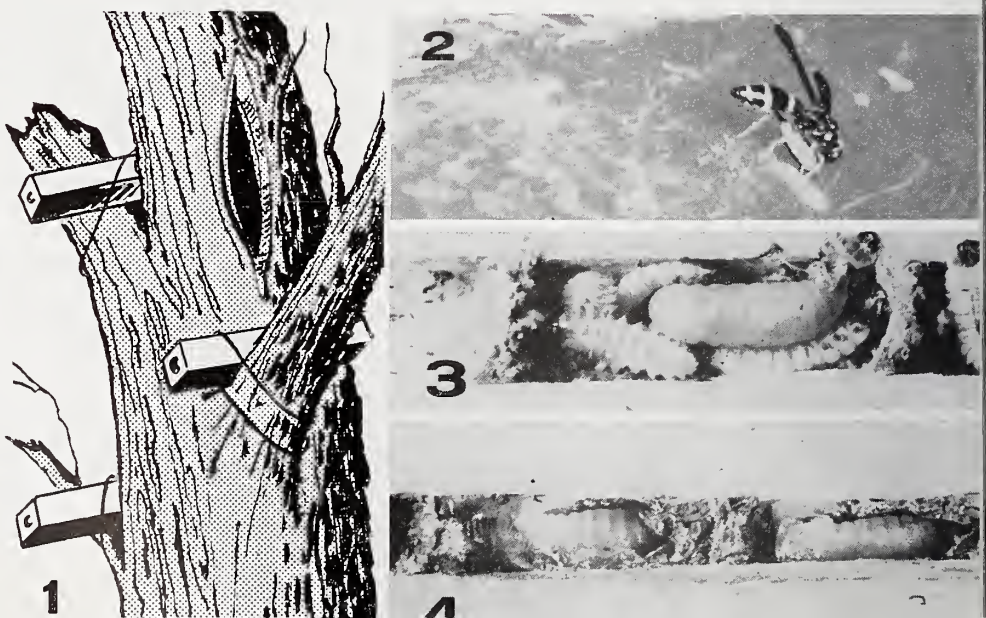
A biological factor: PARASITES & PREDATORS

Studies of parasites and predators (biological, or density-dependent, factors) are numerous. (See AGR. RES., August 1957, p. 8; June 1955, p. 4; December 1954, p. 12; December 1953, p. 8.) Some of these parasites and predators work alone, and some work in colonies. Some tear their prey to pieces. Others oviposit eggs in the host, and still others paralyze their prey.

ARS entomologist Karl Krombein is studying wood-nesting wasps that paralyze prey—leaf-feeding caterpillars, some other insects, and spiders—by stinging. Female wasps are attracted by means of wooden blocks, each containing a hole 6 inches long and $\frac{3}{16}$ to $\frac{1}{2}$ inch in diameter (depending on species of wasp). These traps are tied horizontally to branches of dead trees where wasps would normally search for cavities caused by borings of beetle larvae. The traps, made by Smithsonian Institution, Washington, D. C., are placed in wooded areas of Plummers Island in the Potomac in June. The nests are checked weekly during the summer.

Many species of the genus *Stenodynerus* lay eggs in the blocks, then bring paralyzed caterpillars to the nest. The wasp places an egg inside, then 6 to 10 caterpillars, and builds a clay wall to form a cell. This is repeated until the hole is filled.

Up to 12 cells are constructed. When the end is capped, indicating a full nest, Krombein brings the block back to the laboratory. He splits the nest in half, studies the architecture, and follows the development of the



WASPS (wood-nesting type) are attracted to holes bored in small wooden blocks, which are tied horizontally in dead trees (1). These traps are checked weekly. Having laid an egg in one of the traps, wasp paralyzes a beetle larva (2) and carries it back to the nest. Cells, each with several prey, are walled off with clay. Capped nest is brought back to laboratory. Splitting trap apart later on reveals (3) half-grown wasp larva with beetle larvae. After eating all the prey, wasp larvae spin cocoons (4). Parasites that attack wasps also may be found in nests.

wasp to learn its life history. He learns the identity of the prey and how many the wasp places in each cell. Sometimes parasites that attack the wasps also are present.

(If the wasps were to kill the larvae instead of paralyzing them, decomposition would be rapid, and the eggs would die of putrefaction.)

In North Carolina, New York, and Florida, Krombein has collected other species of wasps with different habits. The information is providing other researchers a basis for more extensive studies to determine the exact importance of these insects.

3

Combined factors: PESTS OF TOBACCO

The combination of factors comprising an insect's entire ecosystem also is under study. ARS scientists are cooperating with North Carolina State College and the North Carolina Department of Agriculture to determine the physical and biological influences that affect tobacco pests.

ARS entomologist F. R. Lawson found the green peach aphid pest of tobacco is affected by a large number of factors, but only 8 variables are of any measurable significance: temperature, rainfall, 4 host plants (tobacco, turnips, collards, and wild mustard), and 2 diseases (a fungus and an unidentified condition that develops in hot weather, sometimes referred to as the hot-weather disease).

Experiments indicated that aphid populations were chiefly destroyed by biological factors, but biological changes reflected changes in the weather. Aphid numbers increased in fall, when host plants were in good condition and temperatures were favorable. But in the winter, when cool weather slowed aphid reproduction, and high humidity and wet soil favored fungus, aphids decreased.

Further decline occurred when extreme low temperatures damaged host plants, but aphids were not killed directly by temperature. In the spring, when temperatures were higher and the weather was dry, aphids increased in tobacco—until the hot-weather disease again reduced their numbers.

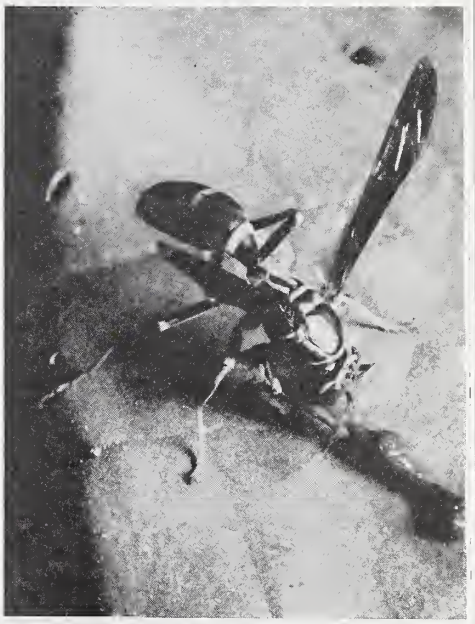
Insects competing with aphids for food, many parasites and predators, and alternate hosts of the two main diseases are not significant.

Studies of hornworms on tobacco indicate that a limited number of enemies destroy the lion's share of the host population because a few of these predators arrive early and get first chance at the food supply.

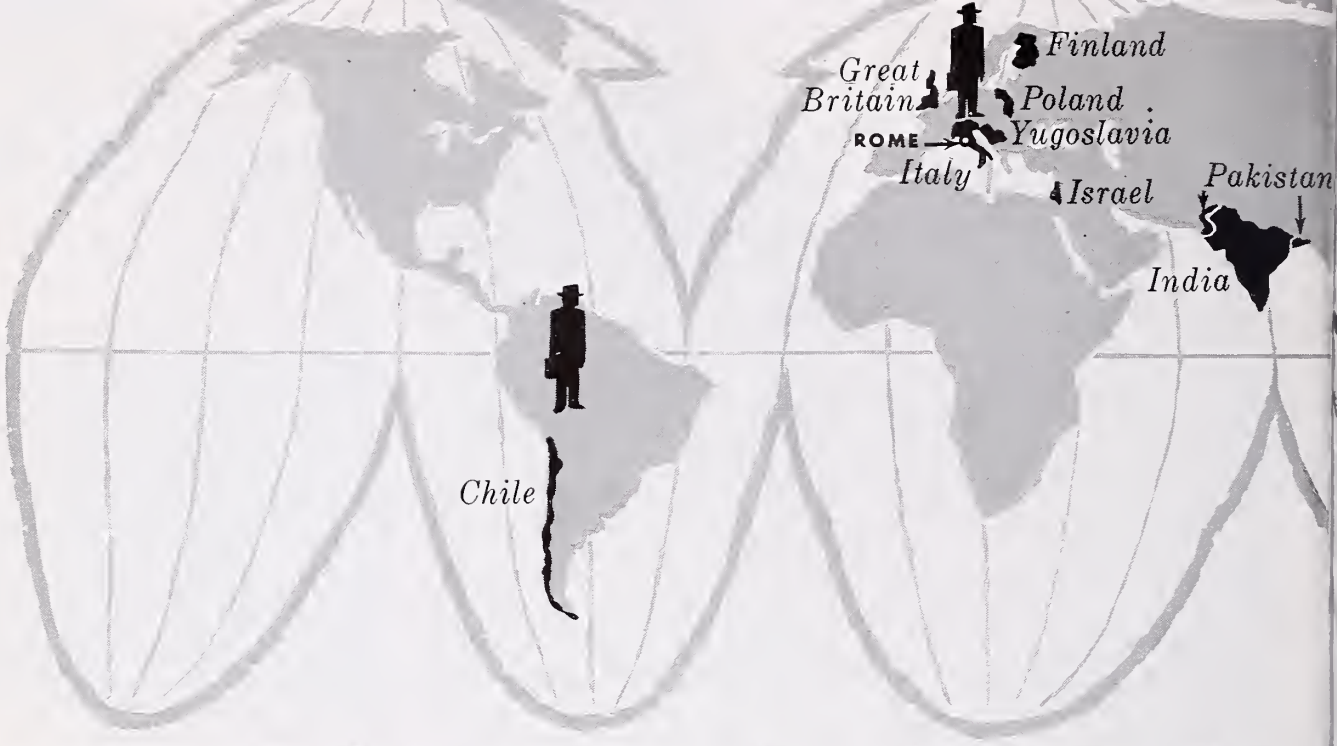
Each of the hornworm enemies has different abilities and limitations and is confined to a separate niche in the life of the host. Stilt bug predators attack eggs, but are too small to kill larvae. *Polistes* wasps carry away larvae of all sizes except the largest, and tear them apart before feeding to their young. Some of the flies from the Tachina family parasitize hornworms too large for the wasps. Sometimes niches of different enemies overlap; then one enemy may destroy another or limit its food supply. Wasps kill many hornworms already parasitized by braconids and eat the parasite along with the host. Braconids in turn may kill the host before tachina-fly eggs can hatch.

Study of the interrelationships in ecosystems is useful for improving control measures. Researchers have learned that aphid infestations in tobacco plant beds can be prevented by controlling nearby patches of winter host plants. And adjusting hornworm spray schedules to make full use of natural enemies can reduce dosage and number of applications. ☆

HOT-WEATHER disease is one of many factors affecting green peach aphid. Dark aphids on tobacco flowers (left) are dead; light ones are alive but many have been sick.



HORNWORM pest of tobacco (below) has several enemies, including wasp *Polistes exclamens* (right). After killing hornworm, wasp feeds on body juices, then rolls meat into pellets and flies them home to brood.



EXPANDING RESEARCH ABROAD

Currencies from our sales of surplus commodities in other countries will finance needed studie

■ Research in foreign countries is being expanded considerably under USDA direction and promises to be of enormous value to us and, to some extent, the countries doing the work (Agr. Res., September 1958, p. 16).

Funds amounting to $3.9 million have been allocated for farm, marketing, and forestry research in Indonesia, Pakistan, Finland, Yugoslavia, Poland, India, Israel, and Chile. It's expected work will expand to include other countries.

Funds amounting to $6.7 million had previously been allocated—and some work begun—for utilization research in Great Britain, Finland, Italy, and Israel. Other countries are also expected to enter into agreement for utilization research.

All research abroad will be done under contracts or grants. Payment will be made out of foreign currencies accruing abroad from sale of our surplus commodities under the Agricultural Trade Development and Assistance Act of 1954 (P. L. 480).

Many values are expected

Benefits from this foreign research may come through expanded markets for our farm output, new uses for farm products, more productive forests, new crops, and greater ability to ward off disease and insect infestations of crops and livestock.

G. E. Hilbert, assistant administrator, ARS, will supervise the research for all of USDA—Forest Service, Agricultural Marketing Service, and ARS. Hilbert will have offices in Washington, D. C. W. M. Scott, assistant to the ARS administrator, will have an office in Rome, Italy, in association with the U. S. agricultural attaché, to head research in Europe and the Middle East. Offices in other areas are also planned.

Surveys are now underway by ARS teams to evaluate facilities and potential of foreign scientists, and to determine the willingness of foreign countries to sanction the research. One team is covering Europe and the Middle East; another, the Far East; and the third, Central and South America. The first two teams are expected to complete their survey by the end of this year; the Latin American team by spring of 1959.

Old-World pests studied

Foreign research will deal with many subjects. Researchers probably will study virus diseases of Asian and European livestock, foreign insect pests, and the means of controlling them. Similar work can be done on nematodes, plant-virus strains, and certain rust races. Such studies could protect us from possible outbreaks of these pests and diseases.

RESEARCH funds are earmarked for shaded countries. Symbols represent teams surveying additional possibilities. Rome is office for Europe, Middle East.

Plant breeding may be done abroad to help our growers improve their crops. Under proposed forestry research, scientists can study foreign insects and diseases—those already in our country or posing a serious threat if introduced—to learn how to control them by biological methods.

Research will be varied

Other possible subjects for foreign research are: genetic traits of foreign livestock breeds; new plants of potential value to commercial and industrial users; studies of soils depleted by centuries of cultivation, for clues on how to restore them; soil-water-plant relationships in certain environments; effects of forest management on permafrost (permanently frozen subsoil); market diseases, market insect pests, and consumer habits and preferences for a variety of commodities in foreign countries. ☆

COCCIDIOSTAT Does Good Job

■ WE STILL DON'T HAVE the *ideal* remedy for coccidiosis, lethal intestinal disease of chickens and turkeys. But we have worked out combinations of various antibiotics that do a *good job* of controlling the disease, at USDA's Agricultural Research Center, Beltsville, Md.

Aureomycin and sulfamethazine gave complete protection to birds, even in cases where 85 to 90 percent of the inoculated controls died from the disease. These results were achieved with 100 to 200 grams of aureomycin plus 1.134 grams of sulfamethazine per ton of feed (567 and 281 grams for turkeys). The drugs were given in the feed starting at time of exposure to the disease and continuing for at least 7 days.

Almost as effective for chickens, too, was a combination of 200 grams of aureomycin and 1.134 grams of sulfaquinoxaline. Both combinations were safely fed to week-old chicks for as long as 3 weeks without harming growth. Chicks with the coccidia organisms grew as well, and in some cases better, than the disease-free chicks on unmedicated feed.

Growth rate of infected turkeys during treatment was equal to that of untreated disease-free birds. But weight dropped temporarily when drugs were withdrawn. (This hasn't happened with the chickens.)

Sulfamethazine or sulfaquinoxaline in the feed at the levels used in the Beltsville tests had no ill effects on growth or feed utilization. Reports elsewhere indicate that it has no ill effects on egg production or hatchability, or the fertility of cockerels. Moreover, both drugs were rapidly excreted by the birds, and concentration of the drugs in the blood dropped promptly after the drugs were withdrawn.

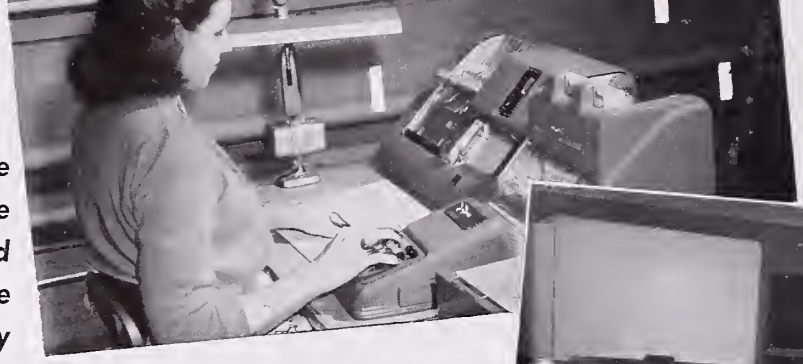
Other Beltsville researchers working with other drugs found that glycarbylamide and nicarbazin—individually used—were effective against the cecal form of coccidiosis. Infected chicks treated with these drugs gained well, and showed only a few mild symptoms of the disease.

Coccidiosis of chickens and turkeys is a general term applied to any of several diseases of the intestinal tract caused by microscopic one-celled protozoans. Some species of poultry coccidia are harmless. Others, slightly harmful, may cause poor growth and decreased egg production without killing their hosts. Others may kill. *Eimeria tenella*, for instance, causes cecal coccidiosis of chickens; *E. meleagrimitis*, severe intestinal coccidiosis of turkeys. Both organisms cause heavy mortality in young birds and lowered vitality in survivors. Survivors tend to make poor gains and are more susceptible to other diseases.

Unfortunately, chickens may be infected for some time before symptoms appear, even in the most severe cases. When recognizable symptoms show—lack of appetite, droopiness, passage of blood, or discharge of water or mucus-laden droppings—it's too late to save the chickens.

The solution is to prevent the disease. To be practical, medication must be effective against the disease, harmless to the birds, easy to put into feed or water, and cheap enough so it won't greatly increase production costs. Medication must leave no harmful residues.

Meantime, USDA continues its search for other drugs or combinations that are effective, long lasting, precise, and economical. ☆



CARD PUNCHER prepares permanent record for each cow from information that's been compiled by DHIA supervisor

Familiar DHIA plans are being made much more flexible and useful, and far more data are made available to dairymen by

MECHANIZING DAIRY RECORDS

Standard DHIA plan

Supervisor comes 1 day a month, weighs and samples each cow's milk. He tests samples or takes them to central office for testing. He may weigh the grain and roughage fed. The supervisor or central office calculates each cow's production for the month, and for her lactation and lifetime to date; also calculates the herd's total production for the month and year to date; and calculates average feed cost and income over feed cost. Costs about 40 cents per cow per month. Records may be used in Sire-proving program.

Owner-Sampler Plan

Owner weighs, records, and samples each cow's milk once a month. He may record weight of each cow's grain and herd roughage. Supervisor or central office samples and records butterfat. Dairyman gets monthly and yearly reports of cows' and herd's production. Costs about 25 cents per cow per month.

Weigh-a-Day-a-Month Plan

Owner weighs each cow's milk morning and evening of 15th day of each month, records weights and (if he wishes) herd feed weight, mails these to central office. Milk record for each cow, production to date, monthly herd total, and year-to-date herd total are calculated. If feed records are reported, total and average feed costs and income over feed cost for month and year are calculated. Costs about 5 cents per cow per month.

THE ELECTRONIC AGE HAS HIT dairy recordkeeping and the result has been generally profitable. Incredibly complex, high-speed electronic data-processing machines (EDPM) are giving farmers more detailed and accurate records than ever on performance of individual DHIA cows and herds (AGR. RES.. October 1955. p. 14).

More and more dairymen are guided by these and similar records in management and feeding and today have their DHIA (Dairy Herd Improvement Association) herds producing at a peak. And production continues to rise. New information from these records is opening up badly needed new research to show us how to interpret and evaluate proved-sire and DHIA records more effectively and how to use them to greatest advantage.

The new mechanized system is only the most recent step, however, in the steady nationwide growth of dairy recordkeeping, which had its beginnings in Michigan back in 1906. From 31 herds of 239 cows in the first association. dairy recordkeeping has grown to an all-time peak of 64,883 herds of 2,118,374 cows in 1958. This represents 10.3 percent of all our milk cows.

Several years ago. USDA dairy cattle researchers and DHIA national headquarters took stock of growing interest in dairy recordkeeping. They recognized the limitations of manual or simple machine calculation for a bigger and more complex operation. (For example, it would take 1 man working every day for more than 50 years to do problems the EDPM does in 3 or 4 hours.)

High-capital dairying demands better records

Perhaps most important. researchers saw that new technology (more equipment and overhead) was increasing

PUNCHED cards are fed to the electronic computer, which sorts and compiles all the information needed to show worth of each cow as well as herd.

HIGH-SPEED electronic machine goes into action and produces data in tabulated form. Scientist analyzes data for farmer's use.

the investment per head in efficient dairying. This revolution requires that milk-producing efficiency be continually improved. And this could best be done by much wider participation in recordkeeping, more detailed records, and much more detailed evaluation of records.

Improvements have developed over several years

Although the new system is the direct result of research by ARS and the Animal Husbandry Department, Cornell University, Ithaca, N. Y., it has really grown out of the experiences, needs, ideas, and pioneer work of many States. Several had worked on similar methods of processing DHIA records. Extension workers in other States had developed ingenious manual and punchcard systems of processing. These developments were especially valuable in paving the way for the electronic method.

First electronic processing of complete dairy records was done for 10 northeastern States about 2 years ago at Cornell's computing center. Similar centers are operating or being established in North Carolina, Ohio, Iowa, and Oklahoma. Other centers in Utah, Illinois, Michigan, Wisconsin, Pennsylvania, and Washington use various types of punchcard calculating equipment and produce similar but not as complete records as those produced by the new electronic system.

Improved systems give added useful information

How are the procedures affected by this plan? The DHIA supervisor still makes his monthly rounds to member farms. He records information on each cow—daily milk weight, butterfat, concentrates fed, dry, freshening, and breeding dates, body weight—and amount and quality of forage fed, price of feed and milk, amount of labor, size of farm, pasture quality, and growth.

Reports are mailed to the nearest State or area computing center. The information is precisely arranged and fed to EDPM, which calculates and assembles the data.

Data analysis tells how much concentrates and roughage to feed a cow, based on her production and weight.

In general, cow, feed, and feed-cost records are kept on a lactation basis. Herd averages are kept on a moving-average basis with each month's report including herd average for the past 12 months. Monthly data includes important feeding and management information such as feed cost per 100 pounds of milk, number of workers, milk produced per farm worker, return above feed cost per worker, and milk per farm acre. The records also indicate when cows should be bred and dried off.

Dairymen can get useful aids for management

The dairyman gets a monthly herd-feeding index (feed input compared to feed required), and a rate of roughage feeding (pounds of roughage per 100 pounds live weight). The feeding index is also calculated to the end of the 305-day lactation period.

With more complete information on lactation, the reliability of sire proofs can be greatly increased. In addition to production data, the complete lactation records will also include such things as days previously dry, days carried calf, calving interval, season of freshening and level of feeding. Proved-sire records will include stablemate averages and corresponding yearly herd averages for each daughter of the sire.

Because of EDPM's great capacity and speed, almost any type of proved-sire data or any tabulations or analyses needed can be produced routinely. Such additional information will be of tremendous value to dairy breeders and artificial-insemination associations. ☆

THE TELLTALE CHANGE IN...

FROZEN STRAWBERRIES

■ FROZEN STRAWBERRIES WILL TELL when they've been mistreated. Their vitamin C (ascorbic acid) begins to change when the fruit is exposed to harmful temperatures. From these changes can be determined what temperatures the berries have been through during distribution and the extent of quality loss that has occurred.

At temperatures above 0° F., vitamin C begins to break down into dehydroascorbic acid and diketogulonic acid. These breakdowns occur at definite rates determined by temperature. Knowing how much ascorbic acid has broken down and what the rate of breakdown is for a given temperature makes it possible to determine the past temperature exposure of the strawberries.

This test can be applied at any point in the distribution of the frozen strawberries, showing total quality losses up to that point. Actually, some changes may take place before freezing. This procedure reveals the cumulative effect of harmful temperatures from the time berries are picked until they're tested.

Researchers at the ARS Western utilization division, Albany, Calif., have worked out objective tests for other frozen foods as well. The handiest quality indicator for peas and beans, for instance, is the ratio of chlorophyll to pheophytin. Chlorophyll changes to pheophytin at an increasing rate as temperature rises.

Another quality indicator is the "thaw index" for frozen fruits. Sugar concentration is normally higher in the syrup than in the fruit. But after a day or two of defrosting, sugar concentration is the same in syrup and fruit. The "color spread" or diffusion is a useful quality test for frozen raspberries. The extent to which red berry color has diffused into the syrup shows the degree of exposure to high temperatures.

These tests are the most recent developments of a comprehensive, long-range study to learn more about the time and temperature effects on frozen products. Early in the study, scientists found that reactions are slow at 0° F. but accelerate rapidly with rising temperatures. Speed of some reactions may multiply several times between 0° and 25° F. Quality losses from each exposure are cumulative. Lowering the temperature after a brief warmup doesn't repair the damage.

These findings enable scientists to develop handling, processing, and packaging methods to protect quality during distribution, as well as objective tests to help maintain quality regardless of season or location. ☆

RESEARCH ON PICKLING BACKS GRANDMOTHER

■ GRANDMOTHER OFTEN PUT some grape leaves in the brine when she started her cucumber pickles, to make them turn out good. She didn't know why it worked, but she was convinced that it did. Now, modern science has proved that she was right, and is well on the way toward finding out why.

Softening of cucumbers has been responsible for pickle manufacturers' losses topping a million dollars in some seasons. Scientists at the U. S. Food Fermentation Laboratory and the North Carolina Agricultural Experiment Station started out to learn what caused this softening.

The scientists discovered that enzymes—chemical substances produced by plants, animals, and microorganisms, and essential for most biological processes, such as digestion—were attacking and breaking down structure of the cucumber. These enzymes were found to be chiefly introduced into the curing brine on withering, moldy flowers attached to the cucumbers.

Damage by the mold enzyme can be controlled by draining the first brine put on the cucumbers, 36 to 48 hours after the tanks are filled, and replacing it with a new brine of the same strength. The draining treatment markedly reduces the softening-enzyme content of the brine and improves firmness of the pickles. This method has been widely adopted by

the southern pickle industry, and works satisfactorily, but a specific, nontoxic inhibitor that inactivates the enzyme would be desirable. That's where the grape leaves came in.

Use of grape leaf is tradition

Use of grape leaves in cucumber pickles has been handed down from one generation to another in home pickling procedures, and is included in very old recipe books. The scientists got supplies of grape leaves and cucumbers, with a supply of extra flowers for good measure, to assure the presence of the damaging enzymes. For additional checks, commercial enzymes were added to some cucumber samples, and for others the enzyme-inhibiting substance was extracted from the grape leaves and used instead of the entire leaf. The grape-leaf extracts prevented softening of the brined cucumbers. Pickles manufactured from the samples were rated *good* by a panel of 10 judges representing 3 different pickle companies.

The scientists not only extracted the enzyme-inhibiting substance, they also tried out a variety of extraction methods and compared leaves from several varieties of grapes to determine which contained the largest quantities of the substance. Leaves of the Scuppernong, a native American variety, yielded the highest concentration of the enzyme inhibitor.

There may be other applications

Larger-scale tests are necessary before the research workers recommend the method for commercial use, but indications are that grandmother's idea has a sound foundation. And since the softening enzymes (pectinolytic and cellulolytic) active in cucumber softening are important factors in processing a great many other food products, it's possible the grape-leaf inhibitor may be useful in other branches of the food industry. ☆

Chocolate that melts where it should—IN YOUR MOUTH

■ CHOCOLATE BARS THAT MELT in your mouth but won't melt in the wrapper, even in hot weather, may soon be here.

Such chocolate bars have been made at USDA's Southern utilization division in New Orleans. Scientists found they could keep the chocolate firm during the hottest weather by adding small amounts of completely hydrogenated fats—cottonseed oil, cocoa butter, and similar substances.

As hydrogen is added to an oil, it becomes progressively more solid. Ultimately, it gets to be a very hard fat when completely hydrogenated.

This hard fat doesn't dissolve at the melting point of cocoa butter but mixes with it and forms a rigid framework around the cocoa butter. This holds chocolate firm, even at temperatures above its melting point.

At normal room temperatures, this treated chocolate is no harder than chocolate without heat protection. It has the same glossy finish as ordinary chocolate and is practically indistinguishable in taste and texture. But when temperatures go up into the high 90's, this chocolate stays firm, holds its shape, and retains the oils that normally leak out.

Adding hydrogenated fats to chocolate for heat resistance is not a new idea. Earlier experiments with other partially hydrogenated fats produced chocolate that wouldn't melt in the hottest weather, but unfortunately wouldn't melt in the mouth, either.

Completely hydrogenated oil doesn't seem to make chocolate feel hard and waxy when it's eaten. If amounts are kept as small as 3 percent of the weight of the chocolate, waxiness is barely noticeable and the chocolate melts easily in the mouth.

Scientists are still looking into the effects hydrogenated fats have on other properties of chocolate. In small amounts, the added fat seems to change the acceptability but slightly. It has no effect on fat bloom—the matted appearance of the coating that often develops on chocolate that has melted, then hardened again.

The most serious disadvantage of this chocolate, from a manufacturer's point of view, is its thick and gummy consistency when melted. In fact, its viscosity is so high that it's impossible to apply a sufficiently thin coating to chocolate-covered candies with commercial machinery.

This consistency may be a problem in making molded chocolate bars. Melted chocolate becomes so thick before solidifying that proper setting of the cocoa fat becomes difficult.

Most manufacturers use a process called seeding to set the chocolate before tempering it. Just before it becomes solid, a bit more cocoa fat is added. This immediately crystallizes the cocoa fat in the chocolate.

But scientists found that the chocolate can be tempered without first seeding it. Cooling it to about 41° F., then heating rapidly to 88° F., and finally cooling to room temperature tempers the chocolate properly without producing much bloom.

The Quartermaster Food and Container Institute in Chicago is cooperating in developing and testing heat-resisting chocolate. Research is being continued to adapt the findings to commercial chocolate bars. ☆

FIRST DEGREE of invasion shows only a few small mesquite plants widely scattered in a good black-grama grassland.

DETERIORATED grassland shows signs of second degree of invasion by mesquite plants. Most of the grass is gone.

IT MAY PAY TO GRUB MESQUITE

Many arid ranges can still be saved for grazing if ranchers control the brush before it converts land into sand dunes

MESQUITE sand dunes completely dominate a once-profitable grassland area in the third and disastrous stage of invasion.

MESQUITE GRUBBING—digging out the weeds with a grubbing hoe—may be an economical way to head off further losses of valuable grasslands in our Southwestern States.

A large-scale mesquite control project early this year on USDA's Jornada Experimental Range in southern New Mexico showed just how practical and economical organized mesquite grubbing can be. Total labor cost in grubbing 4,265 acres of mesquite at 44 cents per acre was $1,876. A total of 2,531 manhours of labor was required, plus 84 hours of supervision.

Brush dominates half the range

Clearing costs are reasonable compared to the long-term value gained.

Honey mesquite (*Prosopsis juliflora*) is gradually taking over and threatening continued livestock production on the semidesert area of southeastern Arizona, southern New Mexico, and western Texas. On the Jornada Range, for example, mesquite-dominated land has increased from 13 percent in 1915 to 49 percent in 1957. This is happening not only on overgrazed land but also on land grazed moderately or not at all.

Mesquite invasion on sandy soils of the Southwestern States is characterized by (1) young plants that are hidden among the grasses, (2) older plants with sand blowouts among them, and (3) the mesquite sand dunes that won't pay for reclamation.

Average normal capacity of th range is reduced from 18 animal-uni of grazing per year per section in th first stage, to 3 animal-units or les of grazing in the third stage.

Practical standards were set

In the recent tests, ARS agronomi Carlton Herbel, range conservatio ist Fred Ares, and New Mexic rancher Joe Bridges laid out fo grubbing 4.265 acres located in different pastures. Only plants whos crowns measured 30 inches or les were grubbed, since researchers fe it would take too long to grub large plants. But occasionally larger plant in a light stand were also grubbe Highest number of plants for ec

nomical grubbing was arbitrarily set at 150 per acre, but areas with occasional dense stands were grubbed.

Eleven grubbers were spaced at 30-foot intervals and kept in line by flags 30 feet apart to insure thorough grubbing. Changing these flags as rows were changed proved to be a full-time job for one man with a pickup truck. Grubbers quickly became accustomed to their spacings after a few days. It would probably be unnecessary to have a flag for each grubber. The scientists think one flag for each fourth or fifth man would be enough to keep all in line. A supervisor followed closely behind the grubbers to check on their work and to grub an occasional plant missed.

Clearing brush took little labor

There were about 82 mesquite plants per acre in the test area. Some 28 of them were too big to grub economically. Only about four grubbable plants were missed. Average time for grubbers, flagger, and supervisor was 0.63 manhour per acre.

The New Mexico work emphasizes the need for grubbing light stands before they get worse. When plants are too large, more expensive chemical control measures must be employed. The studies also show that careful grubbing is needed to completely sever the plant below the budding area of the root. The budding area of plants not mounded with sand is about 4 inches below the surface.

Labor sharing is a possibility

If a rancher doesn't have readily available labor to clear up his mesquite-invaded rangeland, it may be possible for him to make arrangements with a neighboring rancher who does. This possibly would work to the advantage of both.

In studies in Arizona, ARS scientists controlled *velvet mesquite* economically with 2,4,5-T. (See AGR. RES., October 1958, p. 15.) ☆

How to Start CONSERVATION

■ SOIL CONSERVATION IN SOME AREAS with problem soils stands a better chance of farmer acceptance if the conservation plan is shaped to the farm family's pocketbook as well as to the needs of the land.

Many farmers are convinced soil conservation pays in the long run. Nevertheless, a USDA-State study of severely eroded farms in western Iowa showed that few operators there were using contour cropping, terracing, or crop rotations that included enough grasses or legumes.

Why are farmers with land most in need of conservation reluctant to take hold of a paying proposition? Because they cannot afford the expense of starting conservation. That's the evaluation of ARS farm economist R. V. Baumann, who cooperated in the study with A. G. Ball and E. O. Heady, Iowa Agricultural Experiment Station economists.

Along with higher expenses, lower income during a conservation plan's early years was another big hurdle for many of the farmers. For them, providing a family living from current production came first.

But to make ends meet, these farmers struggle to hold up yields from thinning top soil, or to raise crops on erodible land. Without conservation, erosion and soil runoff worsen. As a result, declining productivity cuts deeper into modest capital resources—small savings and limited available land and labor. And the relatively large initial expense to start a conservation plan looks even more prohibitive.

Farmers in this predicament may plow in more of their limited resources or crop more intensively—a soil-depleting practice—to hold up income. In either event, conservation would lose out, for it would cut income for several years. A conservation plan would look good, though, to farmers willing and able to wait for higher future income.

A gradual start toward a conservation plan, the farm economists suggest, would help a reluctant farmer break from his soil-depleting trap. In the beginning, limited soil-saving practices must be fitted to the farmer's available cash and credit for the whole farm business.

Contouring and improved rotations, for example, take the smallest amount of cash and pay off in a shorter period. They would be good starts toward an overall conservation plan, according to the farm economists. Use of commercial fertilizer would also boost income to offset slow-paying erosion controls. Profits from these combined practices would in time allow a shift of some grain acreage into forage. That's a major erosion control.

Where's the farmer to get financial resources for even this tentative start? First, USDA cost-sharing programs can be used to establish some practices. Credit is also needed, usually, to make up for immediate loss of income, and to buy livestock to use the forage.

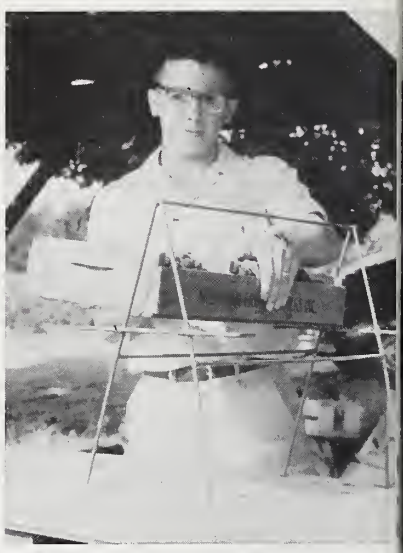
It may take from 5 to over 15 years before conservation systems of farming for erosion control will become profitable. The western Iowa studies showed this. But these studies were based on price levels prevailing in recent years. Higher price levels would, of course, shorten this period, just as lower price levels would lengthen it. ☆

LUG CARRIER AIDS IN PICKING RASPBERRIES

Device is convenient, saves labor and protects fruit

LUG CARRIER makes it unnecessary for the picker to stoop as low as he does when using conventional carriers placed on the ground during picking.

CONVENTIONAL berry lug slips into a specially designed lug carrier, which holds the lug off the ground and provides a means of carrying it. Carrier, a metal frame made of ¼-inch rod, lasts indefinitely.



CHECKER easily removes filled lug from lug carrier at check-in station. Lug is transported to processing plant without pouring out fruit. This eliminates bruising the tender, young berries.

■ RASPBERRY GROWERS RAISING fruit for processing may find it pays to use a specially designed lug carrier to speed up harvesting and keep berries from bruising. This device—originally developed for strawberry growers—is a movable stand with a detachable berry lug.

Cooperative time, cost, and quality studies by Michigan Agricultural Experiment Station and USDA proved the carrier commercially feasible. It means less equipment cost, easier picking, cleaner fruit, and less handling.

The new lug carrier works best with berries destined for processing. Berries going into the fresh-fruit market are usually packed in pints. Growers selling part of their crop as fresh fruit and part for processing may find it hard to switch harvest operations frequently.

The movable stand is made of metal and so designed that a conventional berry lug can easily be slipped in or out of the unit. The stand holds the lug up off the ground and provides a means of carrying it.

Improvement involves little method change

In the conventional method of picking berries for processing, each picker receives a carrier with pint or quart boxes. The filled carriers are then taken to a check-in station where the fruit is poured into a lug. The picker is credited with the berries, empty boxes are replaced in the carrier, and the unit is returned to the picker. The lug is later moved to a processing plant. Carriers for the quart boxes cost the grower $1 or more, and the boxes cost 1 or 2 cents each. These usually have to be replaced at least once a season.

With the new method, each picker receives a unit containing a lug, which is filled and carried to the check-in station. Here it is slipped out and replaced with an empty one that the picker carries back to his row.

Growers provide only the stand, which can be made for less than $1 and used indefinitely. The stand holds the lug up off the ground and pickers don't have to stoop as low as when using carriers, which rest on the ground. Also, dirt can't get into the filled boxes.

Reduced work at check-in also saves berries

At present, berries are poured into other containers at the check-in station. This handling, which bruises the tender berries, is eliminated with the lug carrier. Also, less help is needed at the check-in station. Time studies showed it took three times longer to record a given amount of fruit brought in carriers than to record the same amount brought in lugs.

Some growers object to the weight of a filled lug and stand. They weigh about 18½ pounds, including 13½ pounds of fruit. A carrier with 10 filled pints weighs about 11½ pounds, including 7½ pounds of fruit. Other growers like the fact that the lug holds more fruit and reduces the number of trips to the check-in station. ☆

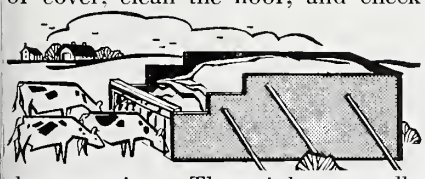
Economy in bunker silos

Use of bunker silos to self-feed cattle can be profitable and save labor and costs if properly managed.

This conclusion was reached in a study of horizontal silos in use on 50 north-central Illinois farms, by USDA agricultural economist R. N. Van Arsdall and the Illinois Agricultural Experiment Station.

Two-hundred-ton concrete or wood bunkers cost from $5 to $9 per ton of capacity. Harvesting and filling took 4 manhours per acre for grass and 6.9 manhours for corn silage.

The study showed that self-feeding need not require daily attention. Moreover, most such operations do five jobs—adjust and move the feeding gate, loosen silage, remove silage or cover, clean the floor, and check



the operation. These jobs normally take about 40 minutes a day per 100 cattle during winter feeding.

Studies showed that each animal needs about 3 to 4 inches of horizontal feeding space. Having just the right number of cattle per silo helps minimize waste, spoilage, freezing in winter, and palatability loss in summer. Researchers emphasize that animals need high-quality forage harvested at the correct maturity.

Researchers found that building silos north to south and open at the south for feeding prevented freezing, particularly of grass silage. Sides of the silos should get the sun for best results or be banked around with earth. Feeding in silos running east to west should be from the east end. Best width for silos in the study was 20 feet, with a depth of 5 to 7 feet of settled silage.

The study also showed that a manger-type feeding gate suspended by a pole from the side walls proved best in most cases. This gate required least labor, provided a good hog barrier, and controlled the cattle. Researchers suggest partitioning the gate into individual feeding spaces and hanging it so the base just touches the floor. Then the support pole should be anchored at least a foot from the silage and kept there until cattle clean up all they can reach.

Witchweed fight starts

An intensive effort to eradicate witchweed, a parasitic plant that attacks corn and some other crops, is getting under way in an 18-county area of North and South Carolina. USDA has a $3-million appropriation to initiate the plan. Agricultural agencies of the two States and farmers in the infested area are cooperating.

The campaign will extend over some 75,000 acres of cultivated land and 20,000 acres of uncultivated land on 3,404 farms. Farmers in the area are being asked to use or permit witchweed-killing practices on their land beginning next spring. Infestations have not been found elsewhere.

Advisory committees meet

USDA's research is receiving fresh guidance and evaluation from the 25 research and marketing advisory committees as they hold their annual meetings this fall and winter. The committees—appointed by the Secretary of Agriculture under provisions of the Research and Marketing Act of 1946—aid the USDA to appraise and plan its research and service to improve the production, marketing, and utilization of agricultural products.

The first meeting—by the Forest Research and Marketing Advisory

Committee—was held October 13–18, at Raleigh, N. C. The Cotton and Cottonseed group meets twice, on a Texas field trip in October and in Washington in February. Food and Nutrition, Sheep and Wool, Refrigerated and Frozen Products committees met in November.

During December the Potato, Rice, Home Economics, Sugar, Dairy, and Economics groups are convening. January will see meetings of the Deciduous Fruit and Tree Nut; Tobacco; Grain; Soils, Water, and Fertilizer; Poultry; Oilseeds and Peanut; and Food Distribution groups.

The Seed, Vegetable, Farm Equipment and Structures, Feed and Forage, Livestock, Citrus and Subtropical Fruit, and Transportation committees will complete the series in February.

Let ultrasonics select

A device that uses high-frequency sound waves (ultrasonics) to determine the depth of backfat and depth and width of loin eye muscles in live cattle and hogs may prove beneficial in livestock marketing and breeding. Such measurements are important in selecting meat animals that produce a high percentage of their weight in more desirable cuts.

Ultrasonic waves go through tissue without harm. Time needed for waves to pass through and bounce back from the interfaces or borderlines between fat, lean, and bone

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varies with depth. These time differences indicate depths of the various interfaces.

Preliminary tests of the device are being conducted by ARS animal husbandmen and agricultural engineers. So far preslaughter measurements of animals by ultrasonics have compared closely with their actual dressed-carcass measurements, showing the apparatus to be highly accurate.

The device may be helpful in selecting and grading hogs and beef cattle before fattening or slaughter to insure proper finish and improve the uniformity of marketed livestock.

ARS scientists also foresee this type of electronic device as a great aid in increasing the effectiveness of breeding work. The increased accuracy it would permit in selection of meat-type breeding stock would substantially reduce the time needed to produce superior lines. It would also save some of the time needed to measure, probe, and judge individual animals by present methods.

Big ewes mean big lambs

Weight of ewes as yearlings just before first breeding is a fairly accurate basis for forecasting birth and weaning weights of the lambs they will produce, USDA work shows.

Heavier ewes—regardless of breed or wool type—produced heavier, faster growing lambs than lightweight ewes in tests by ARS animal husbandman Jack L. Ruttle at the Southwestern Range and Sheep Breeding Laboratory, Fort Wingate, N. Mex. This finding makes possible quicker profits from breeding flocks by enabling earlier culling of animals not likely to have large lambs. Flock owners generally tend to cull their ewes after each has produced a lamb.

Bigger ewes offer another dividend—they provide more skin area for growing wool.

The lightest group of ewes in the 4-year tests averaged 65.4 pounds as yearlings and the heaviest, 92.7 pounds. This 27.3-pound advantage in body weight for the heavier ewes resulted in lambs averaging 1.29 pounds heavier at birth and about 19.5 pounds heavier at weaning.

Weaning weights of lambs in the 3 heaviest groups averaged 2.15, 3.25, and 5.02 pounds more than weights in the lightest group. Differences in birth weights for the heaviest groups, though, were only 0.71, 0.35, and 0.23 pound. The greater difference shown in weaning weights as compared with birth weights is attributed by the researcher partly to greater milk production by the larger ewes, and partly to the inherited factor for greater size of the lambs.

Better way to scour wool

An improved method of scouring raw wool provides harmless but effective cleaning and results in scouring wastes that can easily be treated to reduce stream pollution.

The new method was developed by USDA scientists at the Western utilization division, Albany, Calif., and described by ARS chemist Willie Fong at a recent convention of the American Association of Textile Chemists and Colorists at Chicago.

Studies showed that the alkylolamide-type synthetic detergents—as opposed to presently used nonionic, ethylene-oxide types—are effective wool-scouring agents. Grease and dirt in washing solutions containing these new detergents can be separated easily by cooling and acid treatment, thus keeping wastes from polluting streams. A disadvantage of presently used detergents is that they result in emulsions of grease and other contaminants that are difficult to separate by usual chemical methods. Thus the wool-scouring wastes tend to pollute streams at some plants.

Acid treatment of wastes containing alkylolamide scouring agents resulted in nearly complete removal of wool grease or crude lanolin—a valuable byproduct. Only 60 percent was removed by treatment of wastes containing ethylene-oxide detergents.

The alkylolamide detergents are derived from reaction of fatty acids with alkylolamines. These detergents are used commercially as foam stabilizers in synthetic detergent formulations and for other purposes.

Fat is poor conductor

In the legend over the picture on page 3 of AGRICULTURAL RESEARCH, September 1958, the middle sentence should have read: "Fat is a poor conductor; muscle good."

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